

High-resolution Inelastic X-Ray Scattering at the World's Highest Flux Beamline

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Non-resonant inelastic x-ray scattering (IXS) is a direct probe of the charge density-density correlation function, $S(\mathbf{Q}, \omega)$, in materials at finite momentum transfers, \mathbf{Q} , and energy transfers, $\hbar\omega > 0.001$ eV. This allows one, in principle, to investigate atomic-scale correlations in excited state structure, lattice dynamics, and also high-order multipole components of electronic transitions. However, while IXS provides extremely clean data, the method becomes severely flux-limited as the resolution is improved to the meV level, even at specialized beamlines at 3rd generation synchrotron radiation facilities.

This talk will discuss results and instrumentation at the established BL35XU [1] of SPring-8, and the new RIKEN Quantum NanoDynamics (RQD) Beamline, BL43LXU [2], which will begin commissioning in the fall of 2011. BL35XU is well optimized for meV-resolution measurements of atomic dynamics, providing about 10^{10} photons/s/meV into a ~ 70 micron diameter spot on the sample with an over-all resolution of 1.4 meV and a large 2D 12-analyzer array, for investigating both longitudinal and transverse phonon dispersion. Building on this experience, BL43LXU is designed to be the world-leading facility for investigating electronic and atomic dynamics, with several times the flux as BL35, and other improvements, all aimed toward making previously impossible experiments feasible. Particular targets of the RQD beamline include systematic studies of weak phonon modes in complex materials, atomic dynamics in extreme conditions, and, especially demanding, the investigation electronic excitations such as the orbiton with ~ 10 meV resolution. The new beamline will have a 15-m ID with a 6-mm minimum gap, use mirrors to reduce central cone manageable levels, have a 42-element analyzer array, and employs a new analyzer design (for electronic excitations) to allow large space at the sample while preserving high, ~ 10 meV, resolution with a 2-m arm [3].

[1] A. Q. R. Baron, Y. Tanaka, S. Goto, K. Takeshita, T. Matsushita, and T. Ishikawa, *J. Phys. Chem. Solids* **61**, 461 (2000) and A. Baron, et al, In Preparation.

[2] A. Baron, SPring-8 Information Newsletter **15**, 14 (2010) – (available at <http://user.spring8.or.jp/sp8info/?p=3138>) and A. Baron, et al, In Preparation.

[3] D. Ishikawa and A. Baron, *J. Synch. Rad.* **17**, 12 (2010)